THE GWINNETT ENVIRONMENTAL AND HERITAGE CENTER: WATER-EFFICIENCY AND STORMWATER MANAGEMENT SOLUTIONS FOR THE SOUTHEAST

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Abstract. Completed in August, 2006, the Gwinnett Environmental and Heritage Center (GEHC) was created with the goal of educating a new generation about the region's most precious resource: water. The architecture firm of Lord, Aeck & Sargent designed this "green" building, which is targeted for LEED[i] Gold-level certification by the U.S. Green Building Council[ii]. The Jaeger Company landscape architecture firm was responsible for the site design. Featuring a wide array of sustainable design strategies and products, the GEHC is projected to use 75 percent less potable water and 35 percent less energy than a conventional building of the same size. This paper outlines the various water-efficiency and stormwater management strategies utilized at this unique facility.

Gwinnett Environmental and Heritage Center.

INTRODUCTION

Developed through a collaboration of the Gwinnett County Board of Commissioners, the Gwinnett County Public School System and the University of Georgia (UGA) College of Environment & Design, the GEHC teaches about the importance of water. The center's programs and interactive exhibits – designed for K-12 and adult audiences – explore the impact that water has had on our history and everyday lives as well as the water management challenges we will face in the future. "This will be a place where visitors can learn about the essential role water plays in our lives, where they can learn a little bit more about our community's history, and where people can just enjoy nature," says F. Wayne Hill, former Chairman of the Gwinnett County Commission.

The GEHC is located on a 233-acre forested site in the southern foothills of the Appalachian Mountains. It is also adjacent to the F. Wayne Hill Water Resources Center, a water reclamation plant that treats waste water for rapidly growing Gwinnett County. The site features a creek and several streams, constructed wetlands, a forest amphitheater, council rings for small groups, three covered pavilions, diverse native plant communities, and green space with 10 miles of trails for passive recreation activities such as hiking, biking, and jogging. A paved greenway trail connects to adjacent neighborhoods and will ultimately be a part of a county-wide greenway system.

Building Program. The design of the two-story, 59,000-gross-square-foot facility utilizes locally and regionally harvested materials and features extensive water- and energy-saving strategies and products. Projected to use 75 percent less potable water and 35 percent less energy than a conventional building of the same size, the building is under review for LEED Gold-level certification from the U.S. Green Building Council.

The GEHC blends indoor and outdoor classroom space, exterior landscapes and exhibits, a museum-like

collection of permanent and rotating displays, and interactive learning opportunities. Exhibits meet the requirements of the Academic Knowledge and Skills (AKS) curriculum of Gwinnett County's K-12 school system.

The main floor includes an orientation theater called the Blue Planet, where visitors learn from a film produced especially for the GEHC about the formation and cycle of water and how it's a resource that must be managed. Other features include: Discover H_2O, a room with several hands-on science exhibits; a teaching laboratory for school field trips; other permanent and rotating exhibit space; a library; a lecture hall for community use; a multi-media conference room; a research/resource area; a dining/vending area; a catering kitchen; administrative office space; and a gift shop. The lower level houses three classrooms; additional offices; storage and mechanical space; and shell space for future expansion.

The project's $16.6 million building and site construction budget was funded from Gwinnett County's 2001 and 2005 Special Purpose Local Option Sales Tax. The Gwinnett County School System and UGA also provided funding. The center's operational budget is supported through the Gwinnett Environmental & Heritage Foundation, a non-profit organization set up by the GEHC staff.

REGIONAL CONTEXT

For the project's architect, Lord, Aeck & Sargent, a core component of sustainable design is the creation of *regionally-appropriate* solutions that respond to the unique environmental challenges of a given project. Consequently, the GEHC features design strategies and technologies focused on addressing environmental threats faced by the metropolitan Atlanta region, with a primary focus on the center's mission: water.

Limited Water Supply. The metropolitan Atlanta region, a major U.S. metropolitan area second only to Denver in elevation, relies on drinking water obtained from a relatively small watershed. If current trends continue, the Atlanta Regional Commission (ARC) predicts that water demand will outpace supply within 25 years, becoming the factor that limits the region's growth.

Non Point Source Pollution. The region's population has doubled in the last 20 years. One result of that rapid growth has been the loss of vast areas of forest and farmland, significantly impacting watersheds by covering previously pervious areas with impervious buildings, roads, and parking lots. Non point source pollution occurs when rainfall (stormwater) or irrigation water picks up pollutants and deposits them in rivers, lakes, and coastal waters. Gwinnett County identifies non point source pollution as the largest contributor to local stream and river water quality problems.

Water and Electricity. Electricity generation is the leading contributor to U.S. air pollution, and the connection between electricity generation and the region's urban air quality is widely recognized. However, the connection between electricity generation and water use is less familiar to the general public. The single largest demand for water in Georgia comes from cooling of thermoelectric power plants. With the Southern States Energy Board calculating that 3 gallons of water are used to produce each kilowatt hour of electricity, energy-efficiency is directly linked to water usage.

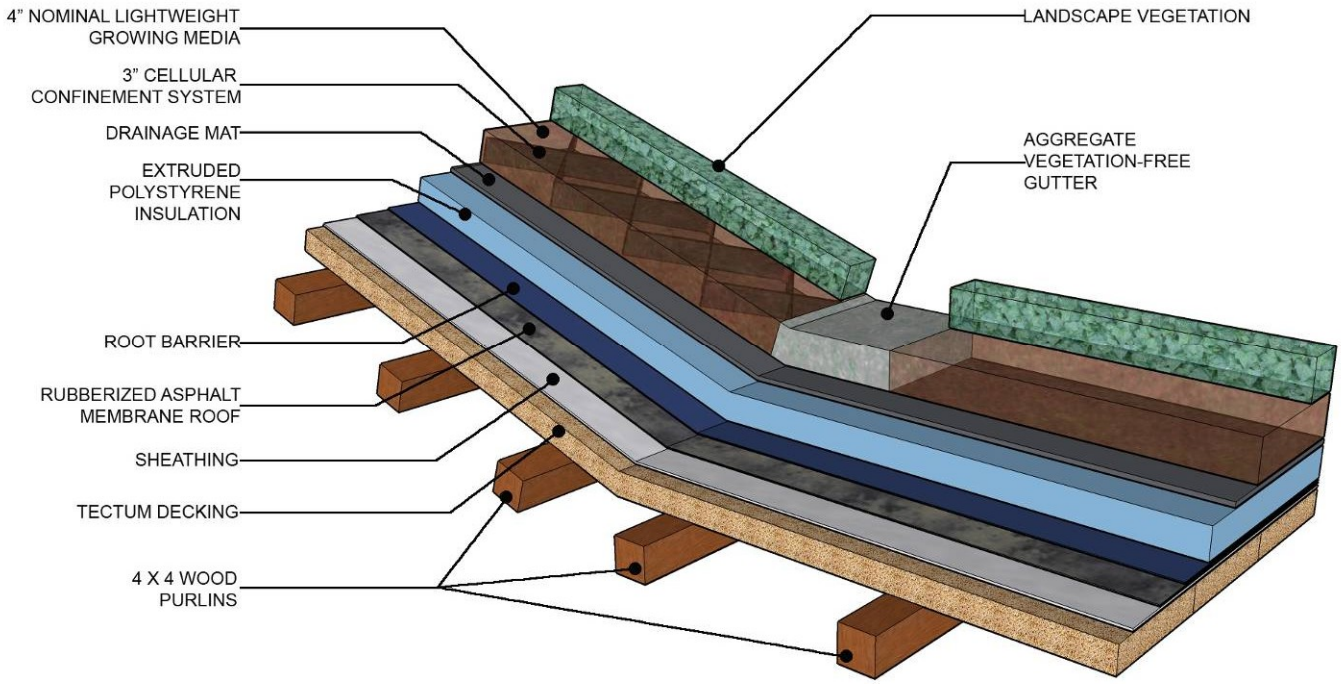
Demonstrating appropriate solutions to the region's water supply and stormwater challenges was a key goal of the GEHC. Consequently, beyond the general environmental goal of LEED Gold level certification, the project team specifically targeted achievement of all of the LEED water-efficiency and stormwater credits. Specific performance targets included a 50 percent reduction in water use, no potable water usage for sewage conveyance or irrigation, no net increase in stormwater runoff from pre-developed conditions, and a 35 percent reduction in energy use.

STORMWATER MANAGEMENT FEATURES

Reduced Grading. At the project's inception, the owner, architect, and landscape architect analyzed the steeply sloping 233-acre parcel to identify a site for the facility that would minimize the need for grading, thereby limiting the associated erosion while protecting the existing tree canopy to provide shade and passive cooling. The facility's parking area and entry drive—sited on a relatively flat portion of the selected site—is divided into three arcs running parallel with the site contours. This allowed the parking to respond to the site topography, forming a series of terraces rather than a monolithic, flat lot.

Rather than creating a uniform flat area for the entire building pad, the building massing also took its cues from the site. Two separate building wings were perched on either side of a dry ravine, with an elevated bridge spanning the ravine. A cascading water feature, integrated with the building's cooling system, was created in the ravine.

Green Roof. The GEHC's most visible stormwater management feature is the green roof covering the entire facility. At nearly an acre in size, the facility's green roof is the largest sloped green roofing system in the United States[iii]. The roof provides numerous advantages over conventional roofing systems, including reducing and



Extensive green roof system isometric.

improving the quantity of stormwater runoff, mitigating the urban heat island effect, providing natural habitat for insects and other wildlife, and reducing the building's cooling loads.

To minimize structural loads on the building's wood structure, an *extensive* green roof system was selected. Unlike heavy conventional (*intensive*) green roofs which essentially recreate growing conditions similar to what you would find on the ground with a deep layer of dirt, *extensive* green roofs are covered with only 2" to 5" of an engineered, light weight growing media. These light weight systems have weights comparable to a conventional gravel ballast roof, and require drought-tolerant plants due to the limited 'soil' depth. The roof system, comprised of a 4" deep engineered growing media, vegetation, and the membrane system, resulted in a 35 pounds per square foot design load.

The majority of the roof is planted with five species of drought-resistant flowering sedums—sedum album, sedum sexangulare, delosperma nubigenum, delosperma kelaidis, and delosperma ashtoni—from a palette developed for extensive green roofs in the eastern United States. Only one of the five species is a southeastern native, though none are considered invasive. In the local Piedmont region, where the GEHC is located, there are many granite outcrops with unique micro-ecosystems. These micro-ecosystems include a palette of native plants that flourish in less than 4" of soil deposits which accumulate in crevices and depressions in the granite. In keeping with the project's goals of reflecting, preserving, and educating the public about the regional environment, an 800 square foot portion of the roof was planted with these native granite outcrop plants, including columbine, silkgrass, purple love grass, and showy primrose, in hopes of providing a test plot for developing a truly native palette of plants for use on green roofs in the Piedmont region.

Porous Paving: Porous pavement systems were used extensively on the site, both in parking and circulation areas serving the building and for the nature trail systems. In keeping with the mission of the GEHC, several different pavement types were used to demonstrate available choices in porous pavement. The facility features over 100,000 square feet of porous paving systems, with the layout and location of the differing pavements relating to their function and the desired aesthetic.

The vehicular driveways and parking lot aisles are formed with porous asphalt. Porous concrete was used for the bus drive and drop off area, and unit pavers were used for the parking spaces. Wheel chair accessible portions of the nature trails were constructed with Slatescape®, a slate-based aggregate that compacts well and is resistant

to washing and erosion on slopes. Most of the remaining trails are formed with mulch.

Natural Stormwater Management. Several methods were used in the management of stormwater to reduce runoff and to encourage infiltration back to the natural hydrology of the site. Piping of stormwater was kept to a minimum, but was necessary in some locations. The green roof drains into boulder splash beds and bioswales in lieu of a conventional piped stormwater system. Porous pavements and the green roof, as described above, were the first step in reducing runoff. Porous asphalt was installed over an 18" aggregate base on un-compacted subgrade. Unit pavers for parking spaces have 1" spaces filled with fine aggregate and are installed over an 8" washed aggregate base. Both of these methods allow for some infiltration of water into the subsoil.

Constructed bioswales are located between parking bays. These collect parking lot water that does not reach the subsoil as well as runoff from the impervious portion of the entry drive that is piped to the beginning of the bioswale system. The bioswales, detailed in accordance with County requirements, contain 4 feet of topsoil surrounded by a stone diaphragm and filter fabric. Perforated underdrains connect to the storm pipe system. They are planted with native plants suited for wet conditions. Water that does not infiltrate through the bioswales is collected in storm pipes and discharged south of the building and downhill of the main water feature into a small constructed wetland. The outfall from the wetland continues to more traditional detention areas.

WATER EFFICIENCY FEATURES

Water-Efficient Landscape Design. No potable water is used for irrigation on the site. Irrigation is supplied by "reuse" or gray water from the adjacent water treatment facility, saving approximately 10,000 gallons of water per hour of total system operation. Drip piping is used in lieu of conventional, inefficient spray heads, to maximize efficiency and reduce water loss due to evaporation.

An entirely native plant palette further reduces the irrigation needs when compared to the exotic, ornamental plants often used in this region. Tree and shrub species planted on-site reflect the surrounding woodlands. Deciduous trees include several oak species, red maple, and tulip poplar. Shrubs include American beutyberry, sweetshrub, summersweet, and piedmont azalea. Once the landscape is established, routine irrigation will be eliminated, with irrigation provided only in times of extended drought or stress.

Domestic Water Use Reduction. Reducing the building's water usage began with analysis to understand the water demand profiles of a conventional commercial facility in order to focus efforts on the largest users. The largest segment of water demand is domestic water usage (i.e. faucets, toilets, and urinals), with domestic water typically accounting for approximately 40 percent of total water demand. Water closets are responsible for nearly half of domestic water demands, with the U.S. Environmental Protection Agency estimating that Americans flush 4.8 billion gallons of drinking water per day. Through identification of the sources responsible for the largest demands, efforts were then focused on identification of strategies for reducing these demands.

With a typical occupant load of 186 persons, conventional toilets at the GEHC would have consumed about 150,000 gallons of potable water per year. That demand was completely eliminated by substituting "reuse" or gray water from the adjacent water treatment facility for toilet flushing.

The second largest domestic water demand came from conventional lavatories, which would have consumed approximately 90,000 gallons of potable water per year. High-efficiency, automatically controlled faucets were used instead, with savings estimated at 50,000 gallons per year.

Finally, waterless urinals were used to eliminate urinal water consumption. These fixtures do not require a water supply line or flush valve. A cartridge, containing a biodegradable sealant liquid that allows liquid waste to pass while maintaining an air trap, replaces the conventional plumbing trap. These fixtures are estimated to reduce water consumption at the GEHC by over 45,000 gallons per year.

In total, it is estimated that these plumbing design strategies will reduce water usage by approximately 245,000 gallons per year, resulting in a building projected to use 75 percent less potable water than a conventionally designed facility.

Waterless urinals.

Daylit interior, © Jonathan Hillyer, Atlanta GA.

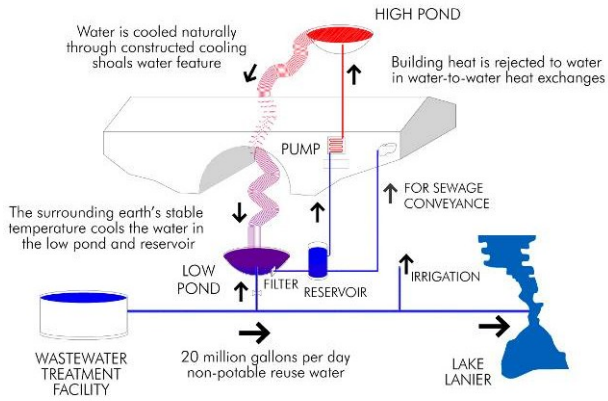
ENERGY EFFICIENCY FEATURES

As outlined in the "Regional Context" section above, energy use is directly tied to water use. Though the LEED Rating System doesn't directly address this connection, the project team approached energy-efficiency measures not just as a means of reducing energy costs and air quality impacts, but also in the context of reducing the facility's water use footprint. Artificial lighting represents the largest component of energy demand in a commercial facility, often accounting for as much as 40 percent of total demand when the associated cooling loads are considered. In the Southeast, air conditioning also represents a significant portion of overall energy demand. Consequently, reducing artificial lighting and air conditioning demands were the key focus for energy-efficiency design measures.

Daylight Harvesting. Daylighting—the deliberate use of sunlight to illuminate building interiors—was selected as a strategy that would significantly reduce artificial lighting electricity consumption while creating a dynamic, productive interior environment. The facility was designed to capture available daylight while preventing unwanted glare and solar gain. All public spaces are designed to be lit with daylight, with automatic sensors that monitor harvested daylight levels and providing supplemental artificial lighting only as needed. Ample windows provide light at the building perimeter, while clerestory windows allow abundant daylight even in the most interior spaces.

Thermal Envelope and Shading. As mentioned earlier, the building was sited to maintain shade from the existing tree canopy. The center's building envelope is well insulated and tightly constructed and high-efficiency windows with low-e glazing reduce heating and cooling losses. The green roof reduces summer roof surface temperatures, further reducing air conditioning loads. Deep roof overhangs throughout supplemented with external vertical shade fins on the east and west glazing reduce unwanted solar heat gain and control glare. Interior, motorized shades further control unwanted glare.

Cooling Shoals Water Feature. The dry ravine between the two building wings was used to create a cascading water feature that provides an interpretive element about the physics of water. The water feature draws clean, non-potable "reuse water" from the County's nearby wastewater treatment facility. The recirculating water is drawn through the building's air conditioning system, providing a heat-sink for rejecting of the building's heat loads. The varying rate of flow through the cascading cooling shoals is governed by the building's air conditioning demands, providing a dynamic interpretive element.



Cooling shoals water feature diagram.

CONCLUSION

The Gwinnett Environmental and Heritage Center features an interpretive center and museum with educational exhibits exploring the impact that water has had on our history and everyday lives as well as the water management challenges we face in the future. The project was designed to function as an interpretive exhibit itself, presenting a working model of regionally appropriate, resource-efficient design. Through the use of visible green building features, supplemented with interpretive exhibits explaining these features and how visitors can make their own homes more environmentally responsible, the facility hopes to be an agent of change in the way the region approaches growth and development.

Cooling shoals water feature and newly planted green roof.

AKNOWLEDGEMENT

We would like to recognize the GEHC's project team for their commitment to creating a successful facility:

- Gwinnett County, Georgia, owner
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- The Jaeger Company (Gainesville and Athens, GA), landscape architect
- Uzun & Case (Atlanta, GA), structural engineer
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- ENSAR/RMI Built Environment (Boulder, CO), energy and daylighting consultant
- Lose & Associates (Lawrenceville, GA), civil engineer
- Van Sickle & Rolleri (Medford, NJ), exhibit designer
- Waveguide Consulting (Atlanta, GA), AV and acoustics consultant
- Huie Design (Atlanta, GA), signage consultant
- Juneau Construction (Atlanta, GA), general contractor

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[i] The LEED (Leadership in Energy and Environmental Design) Green Building Rating System® is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. http://www.usgbc.org.

[ii] The U.S. Green Building Council is a 501(c)(3) nonprofit organization comprised of a community of more than 6,900 organizations from every sector of the building industry united by a common purpose: to transform the building marketplace to sustainability. http://www.usgbc.org.

[iii] Greenroofs.com's International Green Roofs Project Database, http://www.greenroofs.com/projects/, 2006.